

CLAIM REJECTIONS - 35 U.S.C. § 112 - SECOND PARAGRAPH

Claims 6, 12, 13, 14, 28-31, 55, 56, 57 and 63 were rejected under 35 U.S.C. § 112, second paragraph as being allegedly indefinite. These claims have been canceled so this rejection is moot. In light of the cancellation of claims 6, 12, 13, 14, 28-31, 55, 56, 57 and 63. Applicant requests that the rejection of these claims under 35 U.S.C. § 112, second paragraph be withdrawn.

35 U.S.C. § 112, FIRST PARAGRAPH

The Examiner has rejected claims 1-30, 44-62, 70-73, 86-102 and 108-111 under 35 U.S.C. § 112, first paragraph. Claims 1-30, 44-62, 70-73, 87-102 and 108-111 have been cancelled. The only remaining claim rejected under 35 U.S.C. § 112, first paragraph that has not been cancelled is claim 86. Claim 86 depends from claim 85. Claim 85 was not rejected under 35 U.S.C. § 112, first paragraph. Applicant assumes that the Examiner intended to reject claims 87-102 rather than claims 86-102. In any event, Applicant asserts that claim 86 meets the requirements of 35 U.S.C. § 112, first paragraph as does claim 85. Claim 87 has been canceled.

Regarding the Examiner's statement at page 5 of the Office Action where the Examiner indicates "from the specification, it is clear that applicant only has possession of transgenic plants expressing wheat thioredoxin h," the Examiner's attention is respectfully directed to Example 6 at page 53 of the specification as filed, where Applicant describes transgenic sorghum expressing barley thioredoxin h. Further, Applicant directs the Examiner to pages 18-20 of the application as filed where the general principles of plant transformation for various plant types are described. In the present application, Applicant clearly teaches how one skilled in the art would prepare a transgenic monocot plant expressing monocot thioredoxin. In light of the above, Applicant requests that the Examiner withdraw the claim rejection under 35 U.S.C. § 112, First Paragraph.

CLAIM REJECTIONS - 35 U.S.C. § 102

Shi, et al.

The Examiner has rejected claims 1, 2, 3, 4, 8, 11, 12, 13, 28, 30, 31, 32, 33, 41, 44-47, 51, 52, 55-56, 74, 76, 77, 84 and 95-101 under 35 U.S.C. § 102(b) as being anticipated by Shi, *et al.* The rejection is avoided by the amendment to the claims. The rejection is avoided by the amendment to the claims. Applicant has cancelled claims 1, 2, 3, 4, 8, 11, 12, 13, 28, 30, 31, 44-47, 51, 55-56, 74, 76 and 95-101. Claims 32, 33, 41, 77 and 84 have been amended to be directed to monocot plants (claims 32, 33 and 141) and monocot seed and grain (claims 77 and 84).

Applicant's amended claims clearly distinguish Shi, *et al.* Shi, *et al.* describe the cloning of soybean thioredoxin h and the expression of soybean thioredoxin h in tobacco. Both soybean and tobacco are dicots. Shi, *et al.* do not suggest or imply a transgenic monocot comprising a nucleic acid encoding a monocot thioredoxin polypeptide. As such, Shi, *et al.* is distinguished.

Sewalt, et al.

The Examiner has rejected claims 17-18 under 35 U.S.C. § 102(b) as being anticipated by Sewalt, *et al.* Claims 17-18 are cancelled so this rejection is moot.

Van Ooijen, et al.

The Examiner has rejected claims 17-20, 23-24, 28-30, 60 and 61 under 35 U.S.C. §102(b) as allegedly being anticipated by Van Ooijen, *et al.* Claims 17-20, 23-24, 28-30 and 60-61 have been canceled so this rejection is moot.

In light of the above, Applicant requests that the rejection of the claims under 35 U.S.C. § 102(b) be withdrawn.

CLAIM REJECTIONS - 35 U.S.C. §103

Claims 7, 15, 16, 17, 18, 20-26, 50, 58-59, 60-61 & 63-72

The Examiner has rejected claims 7, 15, 16, 17, 18, 20-26, 50, 58-59, 60-61 and 63-72 under 35 U.S.C. §102(b) as being anticipated or in the alternative under 35 U.S.C. §103(a) as being obvious over Shi, et al. Claims 7, 15, 16, 17, 18, 20-26, 50, 58-59, 60-61 and 63-72 have been canceled so this rejection is moot.

Claims 5, 6, 9, 10, 39, 40, 48, 49, 53, 54, 82 and 83

The Examiner has rejected claims 5, 6, 9, 10, 39, 40, 48, 49, 53, 54, 82 and 83 under 35 U.S.C. §103(a) as being unpatentable over Shi, et al. in view of Rivera-Madrid, et al. The rejection is avoided by the amendments to the claims. Claims 5, 6, 9, 10, 48, 49, 53 and 54 have been canceled. Claims 39-40 are now directed to transgenic monocot plants comprising a promoter active in the plant wherein the promoter is operably linked to a nucleic acid encoding a monocot thioredoxin polypeptide. Claims 82-83 are now directed to a transgenic monocot seed or grain comprising a recombinant nucleic acid comprising a promoter active in the seed or grain operably linked to a nucleic acid encoding a monocot thioredoxin polypeptide.

Shi, et al. and Rivera-Madrid, et al. either alone or in combination do not suggest or teach transgenic monocot plants, seed or grain. Shi, et al. teach the cloning of soybean thioredoxin h and the expression of soybean thioredoxin h in tobacco. Rivera-Madrid, et al. teach the cDNAs encoding five thioredoxin h polypeptides from *Arabidopsis*. Soybean, tobacco and *Arabidopsis* are all dicots. Neither of these references are concerned with the problem addressed by the present invention. In particular, these references do not show or suggest producing a transgenic monocot plant, seed or grain that expresses monocot thioredoxin. As such, the Examiner has failed to make out a *prima facie* case of obviousness. It simply would not have been obvious to one of ordinary skill in the art to read Shi, et al. and Rivera-Madrid, et al. and come up with the claimed invention with any expectation of success.

Furthermore, for the sake of argument, even if it is assumed that a proper *prima facie* case of obviousness has been made out, Applicant submits that the case is fully rebutted by the results of the present specification which show, unexpectedly, the expression of thioredoxin in transgenic monocots. (See the discussion below.)

Applicant submits that claims 39-40 are not *prima facie* obvious over Shi, et al. in view of Rivera-Madrid, et al. Applicant further submits that even in the event that such claims would be deemed *prima facie* obvious, the evidence of patentability submitted in the present specification shows that the instant invention is, in fact, non-obvious and is patentable.

Claims 14, 19, 27, 29, 34, 35, 38, 41, 42, 57, 62, 73, 74, 75, 78, 85, 93-94, 87-90, 102 and 108-111

Claims 14, 19, 27, 29, 34, 35, 38, 41, 42, 57, 62, 73, 74, 75, 78, 85, 93-94, 87-90, 102 and 108-111 were rejected under 35 U.S.C. §103(a) as being unpatentable over Shi, et al. in view of Van Ooijen, et al. The rejection is avoided by the amendments to the claims. Claims 14, 19, 27, 29, 57, 62, 73, 74, 75, 93-94, 87-90, 102 and 108-111 have been canceled. Claims 34, 35, 38, 41, 42, 78 and 85 have been amended to be directed to a transgenic monocot plant seed or grain expressing a monocot thioredoxin.

Shi, et al. is discussed above. Van Ooijen, et al teach transgenic plants useful for the production of enzymes in seeds.

Shi, et al. and Van Ooijen, et al. either alone or in combination do not suggest or teach transgenic monocot plants, seed or grain expressing monocot thioredoxin. As discussed above, Shi, et al. teach the cloning of soybean thioredoxin h and the expression of soybean thioredoxin h in tobacco. Van Ooijen, et al teach the cloning of phytase and alpha amylase and their expression in tobacco and *Arabidopsis*. Soybean, tobacco and *Arabidopsis* are all dicots. Neither of these references are concerned with the problem addressed by the present invention. In particular, these references do not show or suggest producing a transgenic monocot plant, seed or grain that expresses monocot thioredoxin. As such, the Examiner has failed to make out a *prima facie* case

of obviousness. It simply would not have been obvious to one of ordinary skill in the art to read Shi, et al. and Van Ooijen, et al. and come up with the claimed invention with any expectation of success.

Furthermore, for the sake of argument, even if it is assumed that a proper *prima facie* case of obviousness has been made out, Applicant submits that the case is fully rebutted by the results of the present specification which show, unexpectedly, the expression of monocot thioredoxin in transgenic monocots. (See the discussion below.)

Applicant submits that claims 34, 35, 38, 41, 42, 78 and 85 are not *prima facie* obvious over Shi, et al. in view of Van Ooijen, et al. Applicant further submits that even in the event that such claims would be deemed *prima facie* obvious, the evidence of patentability submitted in the present specification shows that the instant invention is, in fact, non-obvious and is patentable.

Claims 36-37, 43 and 79-81

Claims 36-37, 43 and 78-91 were rejected under 35 U.S.C. §103(a) as being unpatentable over Shi, et al. in view of Van Ooijen, et al. as applied to claims 14, 19, 27, 29, 34, 35, 38, 41, 42, 57, 62, 73, 74, 75, 78, 85, 93-94, 87-90, 102 and 108-111 above and further in view of Cho, et al. The rejection is avoided by the amendment to the claims. Claims 87-91 are canceled. Claims 36-37, 43 and 78-86 have been amended and are now directed to transgenic monocot plants, seed or grain expressing monocot thioredoxin.

Shi, et al. and Van Ooijen et al. are described above. Cho, et al. teach the barley B1 regulatory regions that direct subcellular localization of proteins in the barley endosperm.

Shi, et al. and Van Ooijen, et al. and Cho, et al. either alone or in combination do not suggest or teach transgenic monocot plants, seed or grain expressing monocot thioredoxin. Neither of these references are concerned with the problem addressed by the present invention. In particular, these references do not show or suggest producing a transgenic monocot plant, seed or grain that expresses monocot thioredoxin. As such, the

Examiner has failed to make out a *prima facie* case of obviousness. It simply would not have been obvious to one of ordinary skill in the art to read Shi, et al. and Rivera-Madrid, et al. and come up with the claimed invention with any expectation of success.

Furthermore, for the sake of argument, even if it is assumed that a proper *prima facie* case of obviousness has been made out, Applicant submits that the case is fully rebutted by the results of the present specification which show, unexpectedly, the expression of thioredoxin in transgenic monocots. (See the discussion below.)

Applicant submits that claims 36-37, 43 and 78-86 are not *prima facie* obvious over Shi, et al. in view of Van Ooijen, et al. and further in view of Cho, et al. Applicant further submits that even in the event that such claims would be deemed *prima facie* obvious, the evidence of patentability submitted in the present specification shows that the instant invention is, in fact, non-obvious and is patentable. (See the discussion below.)

Examiner's Conclusion

The Examiner notes that the specification provides evidence of unexpected results with regard to barley (monocot) plants expressing wheat (monocot) thioredoxin h and wheat (monocot) plants transformed with both wheat (monocot) thioredoxin h and *Arabidopsis* NTR. In addition to this evidence, Applicant respectfully directs the Examiner's attention to Example 6 at page 53 where Applicant describes transgenic sorghum (monocot) expressing barley (monocot) thioredoxin h.

Applicants submits that these unexpected results fully support the amended claims which are now directed to transgenic monocots expressing monocot thioredoxin and effectively rebut any *prima facie* case of obviousness.

In light of the above amendments and remarks, Applicants believe that this case is now in condition for allowance. Should there be any remaining issues that remain unresolved, the Examiner is encouraged to telephone the undersigned.

Attached hereto is a marked up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version with Markings to Show Changes Made." A deleted item is indicated by brackets around the item, e.g., [and], while an insertion is underlined.

In the unlikely event that the transmittal letter is separated from this document and the Patent Office determines that an extension and/or other relief is required, applicant petitions for any required relief including extensions of time and authorizes the Assistant Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to Deposit Account No. 03-1952 referencing 416272001300. However, the Assistant Commissioner is not authorized to charge the cost of the issue fee to the Deposit Account.

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

32. (Amended) A transgenic monocot plant wherein at least a part of said plant comprises a recombinant nucleic acid comprising a promoter active in said part operably linked to a nucleic acid encoding a monocot thioredoxin polypeptide.
36. (Amended) The transgenic plant of claim 35 wherein said promoter is selected from the group consisting of rice glutelins, rice oryzins, rice prolamines, barley hordeins, wheat gliadins, wheat glutelins, maize zeins, maize glutelins, oat glutelins, sorghum kasirins, millet pennisetins, rye secalins, and maize embryo-specific globulin [promoter] promoters.
40. (Amended) The transgenic plant of claim 39 wherein said thioredoxin h is selected from the group consisting of barley, wheat, [tobacco,] and rice, [*Brassica*, *Arabidopsis*, *Picea* or soybean] thioredoxin h.
77. (Amended) A transgenic monocot seed or grain comprising a recombinant nucleic acid comprising a promoter active in said seed or grain operably linked to a nucleic acid molecule encoding a thioredoxin polypeptide.
79. (Amended) The transgenic seed or grain of claim 78 wherein said promoter is selected from the group consisting of rice glutelins, rice oryzins, rice prolamines, barley hordeins, wheat gliadins, wheat glutelins, maize zeins, maize glutelins, oat glutelins, sorghum kasirins, millet pennisetins, rye secalins, and maize [a] embryo-specific globulin [promoter] promoters.
83. (Amended) The transgenic seed or grain of claim 82 wherein said thioredoxin h is selected from the group consisting of barley, [tobacco,] and rice, [*Brassica*, *Arabidopsis*, *Picea* or soybean] thioredoxin h.
112. (New) The transgenic plant of claim 38 wherein said plant is rice.
113. (New) The transgenic plant of claim 112 wherein said thioredoxin is rice thioredoxin.

114. (New) The transgenic plant of claim 38 wherein said plant is barley.
115. (New) The transgenic plant of claim 114 wherein said thioredoxin is barley thioredoxin.
116. (New) The transgenic plant of claim 38 wherein said plant is maize.
117. (New) The transgenic plant of claim 116 wherein said thioredoxin is maize thioredoxin.
118. (New) The transgenic plant of claim 38 wherein said plant is wheat.
119. (New) The transgenic plant of claim 118 wherein said thioredoxin is wheat thioredoxin.
120. (New) The transgenic plant of claim 38 wherein said plant is oat.
121. (New) The transgenic plant of claim 120 wherein said thioredoxin is oat thioredoxin.
122. (New) The transgenic plant of claim 38 wherein said plant is rye.
123. (New) The transgenic plant of claim 122 wherein said thioredoxin is rye thioredoxin.
124. (New) The transgenic plant of claim 38 wherein said plant is sorghum.
125. (New) The transgenic plant of claim 124 wherein said thioredoxin is sorghum thioredoxin.
126. (New) The transgenic plant of claim 38 wherein said plant is millet.
127. (New) The transgenic plant of claim 126 wherein said thioredoxin is millet thioredoxin.
128. (New) The transgenic plant of claim 38 wherein said plant is tritcale.

129. (New) The transgenic plant of claim 128 wherein said thioredoxin is triticale thioredoxin.
130. (New) The transgenic plant of claim 38 wherein said plant is forage or turf grass.
131. (New) The transgenic plant of claim 130 wherein said thioredoxin is forage or turf grass thioredoxin.
132. (New) The transgenic seed or grain of claim 81 wherein said seed or grain is rice.
133. (New) The transgenic seed or grain of claim 132 wherein said thioredoxin is rice thioredoxin.
134. (New) The transgenic seed or grain of claim 81 wherein said seed or grain is barley.
135. (New) The transgenic seed or grain of claim 134 wherein said thioredoxin is barley thioredoxin.
136. (New) The transgenic seed or grain of claim 81 wherein said seed or grain is maize.
137. (New) The transgenic seed or grain of claim 136 wherein said thioredoxin is maize thioredoxin.
138. (New) The transgenic seed or grain of claim 81 wherein said seed or grain is wheat.
139. (New) The transgenic seed or grain of claim 138 wherein said thioredoxin is wheat thioredoxin.
140. (New) The transgenic seed or grain of claim 81 wherein said seed or grain is oat.
141. (New) The transgenic seed or grain of claim 140 wherein said thioredoxin is oat thioredoxin.

142. (New) The transgenic seed or grain of claim 81 wherein said seed or grain is rye.

143. (New) The transgenic seed or grain of claim 142 wherein said thioredoxin is rye thioredoxin.

144. (New) The transgenic seed or grain of claim 81 wherein said seed or grain is sorghum.

145. (New) The transgenic seed or grain of claim 144 wherein said thioredoxin is sorghum thioredoxin.

146. (New) The transgenic seed or grain of claim 81 wherein said seed or grain is millet.

147. (New) The transgenic seed or grain of claim 146 wherein said thioredoxin is millet thioredoxin.

148. (New) The transgenic seed or grain of claim 81 wherein said seed or grain is triticale.

149. (New) The transgenic seed or grain of claim 148 wherein said thioredoxin is triticale thioredoxin.

Digestion: By "digestion" herein is meant the conversion of a molecule or compound to one or more of its components. Accordingly, "digestibility" relates to the rate and efficiency at which the conversion to one or more of its components occurs. In a preferred embodiment a "digestible compound" is, for example, a food, that is converted to its chemical components by chemical or enzymatic means. For example, dextran is converted to dextrin, polysaccharide, monosaccharides, limit dextrin etc; a protein is converted to a polypeptides, oligopeptides, amino acids, ammonia etc.; a nucleic acid is converted to oligonucleotides, nucleotides, nucleosides, purine, pyrimidines, phosphates etc. In a preferred embodiment, the transgenic grains of the invention have increased digestibility, i.e. are more efficiently or rapidly digested in comparison to nontransgenic grain.

Sequence Identity: The similarity between two nucleic acid sequences, or two amino acid sequences is expressed in terms of sequence identity (or, for proteins, also in terms of sequence similarity). Sequence identity is frequently measured in terms of percentage identity; the higher the percentage, the more similar the two sequences are. As described above, homologs and variants of the thioredoxin nucleic acid molecules, hordein promoters and hordein signal peptides may be used in the present invention. Homologs and variants of these nucleic acid molecules will possess a relatively high degree of sequence identity when aligned using standard methods.

Methods of alignment of sequences for comparison are well known in the art. Various programs and alignment algorithms are described in: Smith and Waterman (1981); Needleman and Wunsch (1970); Pearson and Lipman (1988); Higgins and Sharp (1988); Higgins and Sharp (1989); Corpet *et al.*, (1988); Huang *et al.*, (1992); and Pearson *et al.*, (1994). Altschul *et al.*, (1994) presents a detailed consideration of sequence alignment methods and homology calculations

The NCBI Basic Local Alignment Search Tool (BLAST) (Altschul *et al.*, 1990) is available from several sources, including the National Center for Biotechnology Information (NCBI, Bethesda, MD) and on the Internet, for use in connection with the sequence analysis programs blastp, blastn, blastx, tblastn and tblastx. It can be accessed at <http://www.ncbi.nlm.nih.gov/BLAST>. A description of how to determine sequence identity using this program is available at [\[http://www.ncbi.nlm.nih.gov/BLAST/blast.help.html\]](http://www.ncbi.nlm.nih.gov/BLAST/blast.help.html)
<http://www.ncbi.nlm.nih.gov/BLAST/blast.help.html>.

Homologs of the disclosed protein sequences are typically characterized by possession of at least 40% sequence identity counted over the full length alignment with the amino acid sequence of the disclosed sequence using the NCBI Blast 2.0, gapped blastp set to default parameters. The adjustable parameters are preferably set with the following values: overlap span = 1, overlap fraction = 0.125, word threshold (T) = 11. The HSP S and HSP S2 parameters are dynamic values and are established by the program itself depending upon the composition of the particular sequence and composition of the particular database against which the sequence of interest is being searched; however, the values